management looks at computer tape

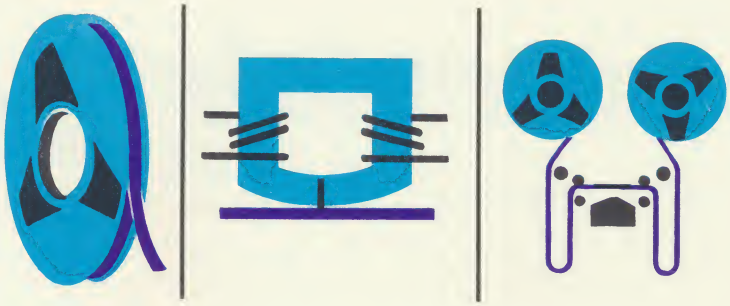
the technical view

GKT

magnetic tape and its accessory— the computer

Any management concerned with a computer should be vitally concerned about tape. The reasons are clear. The installation of the computer was a major step not only in the cost of the event, but in its significance. The possible changes in the structure, the operation and the future way of doing business of the company made it a prime management consideration. Once committed to a computer way of life, the tape library becomes the nerve center of the organization. It represents an investment that may bulk larger than the cost of the hardware. The company's records are on tape. The computer's programs are stored on tape. Should not management, then, be concerned with tape to the same degree that it is concerned with the computer?

This series of booklets—Management Looks at Computer Tape—attempts to survey, in a general way, the techniques and the scope of Tape Management. The present booklet, "The Technical View," discusses the physical characteristics of tape and their significance in computer operations. The second booklet, "The Financial View," discusses the cost management of tape and the tape library. The last in the series, "Improving the View," outlines newly developed equipment, techniques and services available to management for the protection of its investment and for the fullest exploitation of the data center as a profit making tool.



THE DECISION and THE ACQUISITION

The acquisition of a computer is always preceded by a series of management decisions, both visionary and practical. Every effort is made to become an informed practical buyer, and no expense is spared in evaluating and selecting the "right" computer.

On the subject of performance, management is hardheaded. It expects, receives and pays for the utmost in reliability.

In the matter of hardware, for instance, tubes have given way to transistors, and transistors to integrated circuits. There is an increase in the use of redundancy to duplicate operations as a safeguard against failure.

Delivery of the computer is not considered complete until it is installed, debugged and put on an operational basis.

Parity checks and other measures prevent errors in the transfer of information. And the program itself contains time consuming check points and logical cross-footing techniques to minimize the chance of errors.

All these are standard requirements and although they cost extra in money, time and effort, the user rightly considers them essential.

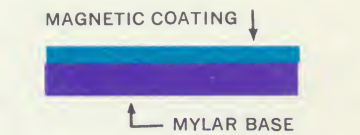
But what about the Tape Library—the storage place of the company records, the programs, and the entire development of the company's data processing technology?

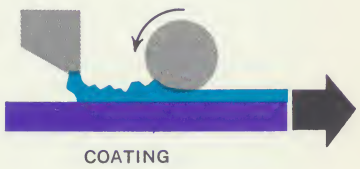
Magnetic tape is the critical and necessary link between the hardware and the software. And yet, for the most part, tape is taken for granted. The product as delivered is usually accepted without test or evaluation. And it is used and reused with no precise standard of judging whether or not it is suitable for future use.

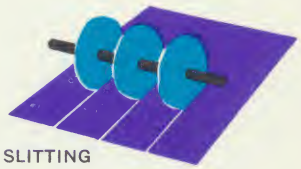
Why the difference in attitude about these two important parts of the system? Is it because tape is such a simple and uncritical item that no stringent acceptance criteria are needed? Is it because the problems of faulty tape are so unimportant or so easily circumvented, that management need not be concerned? Or is it because so little is known about tape?

A look at some of the fundamental characteristics of computer tape might go a long way toward giving the right answers.

tape fundamentals







The notion that tape is an uncritical component is perhaps a natural one. Compared to the computer it appears small; it doesn't contain a complexity of parts or organization and its role is purely passive. Such a notion, while it may be natural, is far from the mark. A few fundamentals show why.

First a Few Numbers. A perfect reel of tape is a seemingly fragile strip of material ½″ wide and a half mile long. It is capable of accurately recording 800 bits per inch (at 112.5 inches per second) on each of seven channels. This means reliably recording 161,280,000 bits—not 161,279,995 reliably and 5 not so reliably—but the entire 161,280,000. Moreover, it must permit the erasure and modification as well as undistorted storage of these bits. Such requirements can hardly be called uncritical. Nor can tape be considered a simple item in view of the processes and controls necessary to meet such requirements.

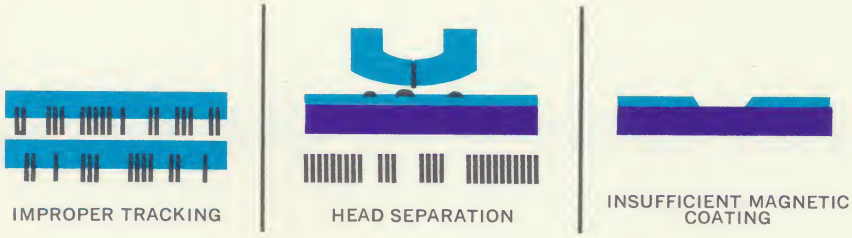
Processes and Controls.
Computer tape is composed of a base and a coating. Both elements require strict controls in producing an acceptable tape.

The Base provides structural support. It is of 1.0 or 1.5 mil polyester film with micro-inch tolerances. Its susceptibility to cold flow and other plastic phenomena makes it a source of difficulty.

The Coating is an iron oxide which provides the magnetic surface. It is evenly dispersed in a binder and painted or printed on the base. Strict controls over the composition, the thickness and the distribution of the coating are essential. Magnetic tapes are not manufactured individually. They are processed in master rolls averaging 20″ in width and then slit. This is equivalent to 20 miles of tape with a profile tolerance of 150 millionths of an inch for its entire length —and a uniform coating over its complete surface with tolerances so tight that a flaw of a few thousandths of an inch can cause a malfunction.

Slitting. After coating, the tape is slit to the proper width by moving through a set of circular knives. Production controls are important not only in maintaining the proper width, but in maintaining parallel and clean edges. In actual fact, the slitting operation, by producing burred edges and debris, is one of the chief sources of tape difficulty.

Without stringent and constant process controls, the quality of the tape will vary significantly. The proven management technique for assuring uniform quality of the delivered product is to establish Vendor Selection Criteria and Incoming Quality Control Procedures. Such procedures are standard in the efficiently managed computer installation.



THE SOFTEST PART OF THE HARDWARE

Prior to the acquisition of the computer, management has two main concerns.

(a). How can EDP be exploited to the best advantage of the company?

(b). Which is the proper computer?

After the acquisition, however, another aspect of the computer becomes critical. It has now become a thing to manage rather than to evaluate, and the concern is not only with its capabilities, but with what it takes to live with it.

The problems are many. They range from decisions about the size, the location, the staff and future expansion of the computer center—to deciding the best way to integrate numerical techniques into the process of corporate planning.

One of the major concerns is how to keep operating properly. By and large, the computer user is spared this responsibility. Regular and special maintenance of the equipment is generally handled by the manufacturer's customer service engineers, with one notable exception—the tape.

Magnetic tape is a kind of hybrid element. It is certainly an intrinsic component of the system, and yet it is not treated as part of it. Nor is regular engineering maintenance extended to it. And yet tape, for many good reasons, is the softest part of the hardware. This becomes clear when we consider that to a large extent tape is mechanical rather than electronic. As such, it is susceptible to the problems of all mechanical devices—wear, alignment and environment. In the case of tape, these problems are even more critical because of the small dimensions and the close tolerances involved. Extremely small deviations can cause the tape system to function improperly. The net effect is an error.

The Dropout. The most common tape-caused data error is the dropout. It is usually the result of a flaw in the tape that prevents the transfer of the signal between the tape and the read/write head. This lack of signal can cause two kinds of errors: (a) data can be obliterated or (b) data can be misinterpreted, i.e., a 1 can be mistaken for a 0 or a 0 can be mistaken for a 1 (a noise error). Dropouts can occur while writing or reading. There are three main causes of dropouts:

1. Misalignment of the Head. In order for the reading head to pick up the information from the tape the head must be positioned exactly over the data track. A change in the angular or dimensional tape/head relation of a few thousandths of an inch can cause an error.

2. Insufficient Magnetic Coating. Bare spots on the tape due to wear or manufacture will produce dropouts.

3. Separation between the Tape and the Head. This is the most common and most serious problem with tape. In order for the tape system to function properly the tape and the recording head must be in positive contact. A gap need only be 150 millionths of an inch to result in the loss of a signal. Generally speaking, there are two main sources of this type of trouble: (a) Something intervening between the head and the tape and (b) The tape may be distorted so that it will not lie flat against the head. The following two pages will discuss the two main sources of these flaws.

THE SOURCE OF THE FLAWS

dirt

FOREIGN DIRT

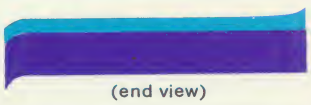
WEAR PRODUCTS

temporary

permanent

SCRATCHES

BURRED EDGES



(end view)

The primary cause of magnetic tape failure is the loss of contact between the recording surface and the heads. The chief reason for this is dirt on the surface of the tape. GKI research has established that 75% of separation failures are due to dirt. The two main types are Foreign Dirt and Self Dirt.

Foreign Dirt. Some flaws are due to foreign objects—dust, lint, cigaret ash, etc.—on the tape surface. They can occur during manufacture or in the computer room environment. The computer room is especially vulnerable since friction between the tape and the guide surfaces creates an electrostatic charge which attracts airborne particles. Other dirt traps are oil film and grease due to careless handling.

Self Dirt. By far the biggest source of tape flaws is Self Dirt—chips and pieces of the magnetic oxide or plastic backing which have found their way onto the tape surface. Some common types are:

Slitting Debris. During manufacture the abrasive action of the knives leaves chips of the material loosely attached to the edges. In use, where there is violent motion, some of these chips are dislodged and fall on the tape surface. Eventually they come between the head and the tape, and cause a dropout.

Burred Edges. Due to the shearing effect of the slitting knives, the tape edges may become burred. The wearing action of the rollers and tape guides eventually removes this burr and deposits it on the surface as error-causing dirt.

Scratches. Frequently, a jagged particle of dirt will adhere to the head or other sliding surface and scratch the tape. This not only produces errors but manufactures other error-causing dirt.

Temporary Flaws. Dirt on the tape creates a lump on the surface which will separate the tape from the head and cause the loss of signal. Initially, these lumps lie loose on the tape. They are called temporary flaws because they are not permanently attached to the tape. Some of these temporary flaws are removed by the cleaning screen on the tape drive.

Permanent Flaws. As the tape is used and reused, temporary flaws become bonded to the surface due to the partial melting and sintering which occur when the tape passes at high speeds over the recording heads, guides and other elements of the tape drive. These flaws are now permanent and will cause an error each time they pass over the head.

distortion

Next in importance to dirt as a source of tape error is skewed or crooked tape. This may result from a poorly controlled slitting process during manufacture, but the main cause is improper winding. Since the tape is almost entirely plastic, it is subject to cold flow. This is the tendency of the material to assume a semi-permanent or permanent change in shape due to stress placed on it. Such distortion can prevent the tape from lying flat against the reading head, and can result in a dropout. Some distortion considerations are:

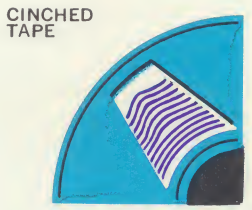
Cinched Tape. Severe damage in the form of folds can be traced to improper winding tension control. Looseness at any point in the roll will eventually cause the tape to slip during storage, and create a series of error-producing folds.

Scrambled Winding. When tape is rewound at high speeds, as on most modern tape drives, it is very difficult to guide properly and is subject to so much air inclusion that sideways flutter is frequently developed, and tape is in effect wound from side to side between the limits of the reel flanges. Storage for even very short periods (hours), will result in semi-permanently skewed tape which will not run flat and straight.

Creased Tape. This is a serious form of flaw in that it cannot be repaired. Horizontal creases result from improper handling and from cinching. Longitudinal creases are caused by severely misaligned guides or rollers in the tape handler.

Edge Ripple. This is an important source of tape failure. It appears as a tendency for one edge of the tape to become stretched or curl, and normally is accompanied by excessive wear and migration of debris from the damaged edge. Edge Ripple is caused by poorly aligned tape drives or, more commonly, by magnetic tape reels which do not meet specifications for straightness.

Performance and Maintenance. The foregoing discussion shows that tape is susceptible to damage and that a perfect tape is not likely to remain perfect very long, once it is put into use. Most tape flaws can be repaired; some cannot, and will measurably shorten the useful life of the tape. All flaws, however, will cause operating difficulties, and should be eliminated when possible. This means a program of Preventive Maintenance—setting up Acceptability Standards, Periodic Inspection, and Cleaning and Repair where indicated.



SCRAMBLED WINDING

tape trouble

MOLEHILL or MOUNTAIN?

It has been shown that tape quality cannot be taken for granted, and that tape, without maintenance, is highly susceptible to failures which can result in lost or incorrect data. The question can still be asked: How serious are the problems of tape?

A detailed discussion of this in terms of dollars is contained in the companion booklet: "Management Looks at Computer Tape: The Financial View." Generally, however, we can point to three things that can result from tape trouble. (a) Lost or Incorrect Data. (b) Inefficient Use of Machine and Operator Time and, (c) Wasteful Use of Tape Library.

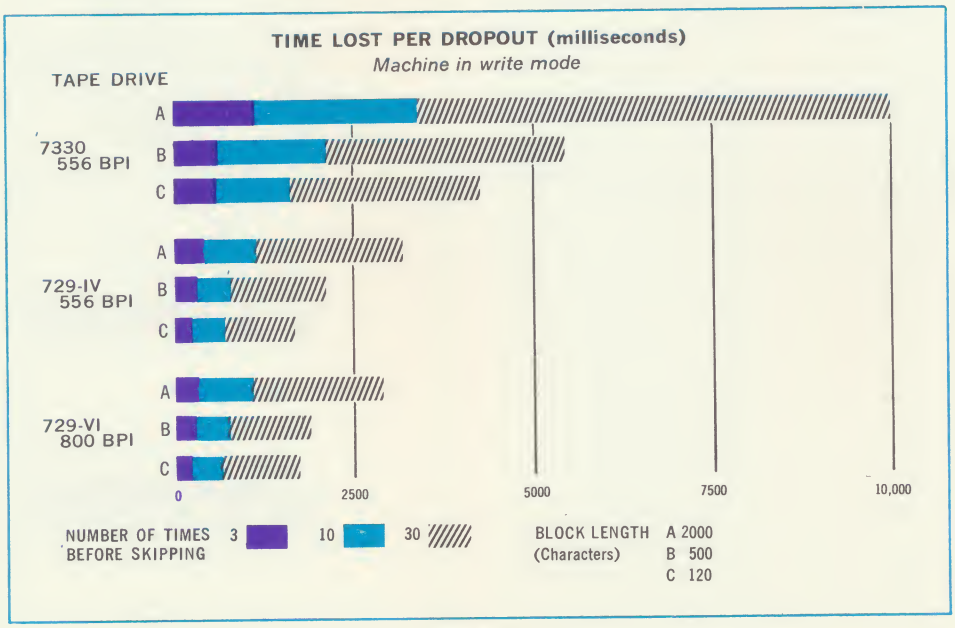


CHART I

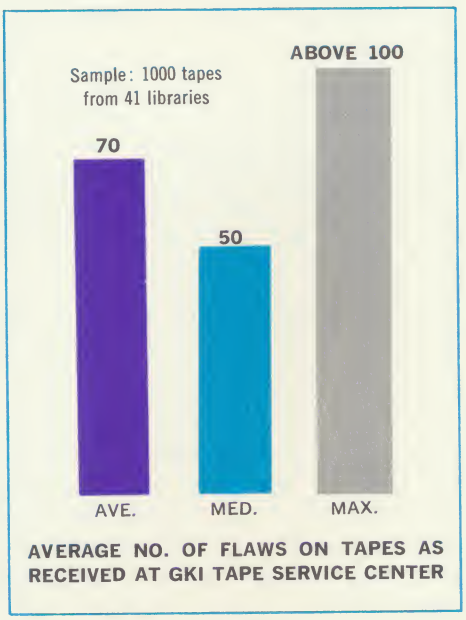


CHART II

Chart I indicates the time lost due to a single flaw in some standard tape systems. The figures refer to the time lost when attempting to write information on the tape. Far greater is the time lost per error when reading—as much as 60 times according to one source.

Chart II shows the average number of flaws in a random sample of 1000 tapes as received at the GKI Tape Service Center. These tapes were sent to the Center from 41 representative computing installations throughout the U.S.

The two charts give an idea of the time that can be lost due to tape. The figures, however, give an indication of the difficulties only as they pertain to the tape. Other and more serious problems such as destroyed records, incorrect results, and the restoration of lost data are more difficult to measure directly. There is, nevertheless, a great deal of evidence of the seriousness of tape problems to be found in the attitudes and activities of the industry in general. A look at some of them might be revealing.

Advertising. An examination of the advertising messages of the tape manufacturers provides a strong measure of the importance which the large and sophisticated buyers of computer tape attach to dropout-free tape. The emphasis in the sales literature or in the specifications of every tape manufacturer is on "quality controlled, tested, dropout-free, clean tape."

Design Changes. Equipment manufacturers are putting forth significant efforts to minimize tape difficulties. Recently, one tape drive manufacturer announced the development of a new design which will eliminate or reduce the tape damage due to the friction characteristic of previous designs. Another has improved the design of reels to reduce tape damage during handling, operation and storage.

Operating Policies. Standard checking features are part of all equipment and programming. In addition, operational procedures have been installed to counteract the presence of dirt in the tape's environment. One procedure used in a number of installations is to stop the computer every two hours and clean the heads and other friction areas. From this, one gets some notion of the importance of cleaning the tape.

Research. The subject of tape flaws is a major one. Intensive research programs, both formal and informal, are being conducted by Government and private installations to determine:

The Dollars Lost
Total Cures
Specific Remedies

Operating Experience. The operating experiences of well-run computer installations have been published in articles, reports and among user groups. The subject of tape failure is an active one.

One well-documented report, for instance, describes an effort to fix the cost of rerun time due to tape errors, and arrives at an average of 3.76 hours a month or $11,000 a year.

Another provides evidence that the small, "relatively unaware" user suffers the largest proportional loss in money due to bad data.

One case is described in which the person lost not only two hours of 7094 time but part of two weeks of his own time due to three bad records in 4000. Some 1401 and operator time were also lost.

One user, in what might well be a summary of the industry's experience, concludes that the principal cost of tape trouble is loss of accuracy, loss of computer time for "shot-down" runs, the production cost of restoring lost data and the extra human effort entailed.

THE TAPE MANAGEMENT PROGRAM

What It Is. For those managers who have recognized the problems of tape, an organized program of tape control has become a way of life. Each has approached the problem in his own way and according to his own needs. Consequently, there is no universal tape program. Nevertheless, every effective program covers at least the following activities:

Checking new tapes.
Periodic testing of library tapes.
Removal of bad tapes.
Installation of handling procedures.
Rehabilitation of restorable tapes.

The fully organized program embraces the entire range of Objectives and Techniques of tape management.

Objectives. In a formal tape management program two main objectives are generally recognized. (a) Reliable or trouble-free tape operation and (b) The efficient use of the tape library.

Techniques. The techniques needed to achieve these objectives fall into two classes: (a) Physical and (b) Functional.

Physical Techniques include Quality Control, Preventive Maintenance and Handling Procedures.

Functional Techniques apply to Record Keeping, Buying Policies, Library Organization, Tape Scheduling, etc.

Who Is Responsible. The tape management program is clearly the responsibility of the computer manager. No one else is in a position to institute and carry out this program for getting the most effective use of the library. Likewise, the responsibility for the physical condition of the tape cannot be delegated. Tape manufacturers have done an excellent job in producing a high quality product. However, they can only be responsible for the initial condition of the tape. It is up to the Data Processing Manager to see that only trouble-free tape is reused.

How It Is Started. The tape management program invariably begins with management realization of the importance of tape.

What is the full investment in the tape library? How much do tape flaws cost? What kind of control is there over vendors? How much is known of the tape's history from procurement to discard? When questions such as these are faced squarely, a tape management program inevitably results. The first steps are usually developmental ones.

Some managers start with a specific problem such as the establishment of handling procedures and tape scheduling. Others with big computers have gone to considerable effort to build tape error logging capability into their operation. Their purpose has been to spot troublesome tapes so that they may be removed from the library.

More recently, computer managers have found it to their advantage to consult tape management specialists before organizing their own programs. There are good reasons for this. Recognition of the problems of tape has led to the development of specialized techniques, equipment and services which can greatly simplify the whole process of tape management. Of these specialists, GKI has the most successful record of service and has developed more tape preventative maintenance equipment and techniques than any other independent organization.

GKI specializes in tape services and equipment. It offers:

Research-Consultation. In all phases of library organization and tape use.

Equipment. GKI has developed a full range of tape maintenance equipment covering three important functions of tape control:

Testing Equipment. GKI Tape Testers and Certifiers provide an effective and simple means of checking tape to see how many errors will result when it is next used on the computer. Each GKI tester produces a chart which shows at a glance the number and location of error-producing regions on the tape. This is used as a guide in deciding whether the tape is suitable for re-use, is in need of cleaning, or should be discarded.

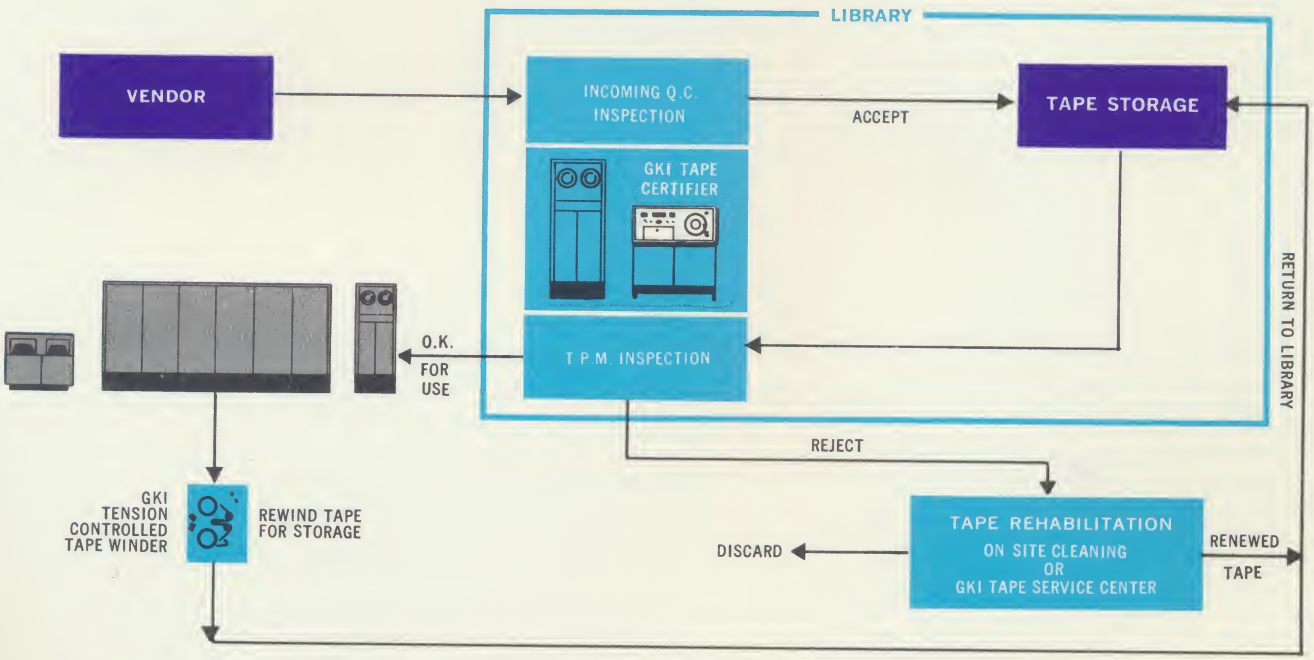
Cleaning Equipment. GKI Tape Cleaners are highly effective in removing dirt which causes tape errors. With GKI's patented KINESONIC process and its self-sharpening dry cleaner, each installation can choose equipment tailored to its individual requirements. The cleaner will normally be used on those tapes identified by the tester as being in need of rehabilitation.

Winding Equipment. A significant percentage of tape errors is due to improper winding. Use of a GKI Precision Winder on tapes destined for storage can forestall this trouble, and take advantage of the cold flow properties of the plastic to correct previous damage such as pock marks and stretching.

Tape Services. The easiest way to embark on a Tape Preventive Maintenance (TPM) Program is through the GKI Tape Service Center. Tapes are tested, cleaned, inspected, repaired, precision-wound, repackaged and returned to the user with a report of their condition. At a modest cost, a "before" and "after" study can be made on tapes selected from the library, asking the Center to perform the complete rehabilitation cycle or portions of it.

The diagram below shows how a basic TPM Program is integrated into the operation of the computing center. For a discussion of the organization, and equipment for the Tape Library, contact the GKI office in your area.

FLOW OF TAPE THROUGH THE COMPUTER FACILITY



GKI

GENERAL KINETICS INC. 2611 Shirlington Road, Arlington, Virginia 22206

GKI

equipment and services for magnetic tape users

general catalog

GKI *background*

GKI was organized in 1955 by a group of scientists, engineers, and mathematicians having strong backgrounds and experience in design, development and application of digital computers and magnetic recording systems.

Research projects were initiated under both Government and company sponsorship, into the relatively unknown areas of magnetic tape performance, operational use, and storage conditions. Research expanded to cover all types of tapes and tape handlers —computers, instrumentation, and video.

Out of this intensive research, covering in excess of 40 separate and distinct characteristics of tape which affect the operating reliability of magnetic recording systems, has grown a broad line of equipment and services.

This experience was extended to answer the needs of tape users for Tape Preventive Maintenance (TPM). Tape Preventive Maintenance heads off tape problems before they cause trouble and run up costs. GKI-developed maintenance equipment, services, and procedures are now regularly supplied to tape manufacturers, government qualification and acceptance testing laboratories, instrumentation installations such as missile and space flight projects, and—increasingly—to EDP installations.

GKI Tape Service Corporation, a wholly owned subsidiary of GKI, was formed in 1963 to provide contract tape rehabilitation services for both industry and government.

YEARS OF EXPERIENCE REALLY COUNT

GKI has over 50 scientists, engineers, and tape specialists involved in continuing research on tape problems, design and manufacture of TPM equipment, and operation of Tape Service Centers. Our research and related experience extend over 11 continuous years of operation. Hundreds of man-years of specialized experience make GKI the leader in TPM.

this catalog covers the complete line of tape handling equipment manufactured by General Kinetics Inc. In addition, it includes a presentation of the magnetic tape cleaning and certification services offered by GKI Tape Service Corporation, Arlington, Va.

Since its introduction in 1955, the General Kinetics line of tape equipment has undergone extensive development, expansion, and refinement. Today, General Kinetics offers the most complete and comprehensive line of tape certifiers, cleaners, degaussers, and rewinding instruments on the market. In addition to the equipment shown in this catalog, GKI has developed and built on special order a large variety of magnetic tape equipment for a multitude of purposes—for measuring and maintaining the performance of magnetic tape. For example:

Special Tape Equipment designed & manufactured by GKI

Model TC-1 Dropout Detector
Designed to measure dropouts as specified in government specification W-T-0070.

Model TC-2 Seven track version of Model TC-1

Militarized Programmed Tension Winders

Reel Gauges

Magnetic Tape Wear Testers

Magnetic Tape Layer-to-Layer Adhesion Testers

Special Reels

Model CW Wide Web Cleaners

Magnetic Tape Skew and Friction Testers

Rapid Loading Stress-Strain Testers

Uniformity Testers

Reissue Testers

Tensiometers

General Kinetics continues to pioneer in basic research into the properties and performance of magnetic tape, performing a wide variety of specialized contracts for the Government, for magnetic tape manufacturers, and a host of other commercial enterprises. GKI equipment is widely used by NASA, Department of Defense activities, computer manufacturers and users, and by the manufacturers of magnetic tape.

THE GKI MODEL 97

tests tapes

rehabilitates tapes

checks new tapes

In the present era of sophisticated computer operations, the demand for greater accuracy and less computer "down time" has sharply increased. One of the major causes of computer errors, and ensuing down time, are magnetic tape "dropouts", errors produced by dirt and loose magnetic oxide particles, as well as inherent tape flaws. The GKI Model 97 provides the computer user with a powerful tool to analyze and certify computer tapes. The 97 *tests, locates,* and provides a rapid and convenient facility for *elimination* of error-producing flaws on the tape.

GKI model **97** COMPUTER TAPE TESTER

The Model 97 Tester is the most versatile instrument of its type on the market—it can be utilized with a wide variety of computer tapes varying in size and hub types. A choice of magnetic signal and noise test heads permits free choice of format, whether it be 7 track, 9 track, or the new Total Surface Testing technique. Packing densities from 200 to 1600 bpi (3200 fci) are available as standard equipment. Tape widths greater than ½ inch can be accommodated, together with non-IBM formats, to suit customer requirements.

The Model 97 has been adopted by computer installations, both government and commercial, as well as by a wide number of tape manufacturers. The 97 can be employed readily in production certification of computer tapes by offering both signal and noise testing on a single pass—in fact, both 7 and 9 track formats can be accommodated simultaneously on a single pass if desired.

COMPATIBILITY. *Assured complete IBM compatibility for 7 track, 9 track, or Total Surface Testing capabilities by utilization of IBM specifications, heads and guide components.*

FLEXIBILITY. *Provides varying densities from 200 bpi to 3200 fci with combinations of 7 track, 9 track, and Total Surface Testing formats. Instrumentation testing configurations* may be provided using standard modular units.*

AUTOMATIC. *Provides automatic loading of tape in vacuum towers, automatic stop and start of test, plus automatic stop on error if desired.*

PRODUCTIVITY. *Allows high production rate through simultaneous signal and noise tests on one pass and automatic stopping for error examination in either forward or reverse direction. High speed testing up to 150 ips available on optional basis.*

MAINTAINABILITY. *Modular construction—front face accessibility to circuit cards, calibration drawer, and logic circuitry.*

CONSTRUCTION DETAILS. *Precision cast base plate for accurate mounting reference of all mechanical drive components. Highly accurate, low drift, solid state circuits.*

CALIBRATION. *Flexibility in calibration techniques provides for various threshold levels used in dropout and noise detection to accommodate the test requirements of the particular application.*

NON-OBSOLESCENCE. *Complete modularity of both electronic and mechanical components assures the owner of the ability to use his Model 97, for future, updated, revised computer tape track and density formats, as required.*

PRINCIPLE OF OPERATION

As the tape leaves the supply reel it is magnetically saturated and checked for noise errors. Following this it passes on to the signal (write/read) heads for test. All noise and signal errors detected are recorded on a graphic chart and are totaled on a counter. Hence, there is a complete record of all tape defects, whether they be caused by drop-outs, time displacement errors, noise pulses, or erratic tape widths. The 97 provides capability of stopping the tape when an error is detected, positioning the area of the error at a convenient repair or observation station to permit study or repair of the defect. Microscopic examination is provided if desired. The work area is conveniently large (10" x 4½") and is specially illuminated. All noise and dropout errors stop at the same point on the observation station.

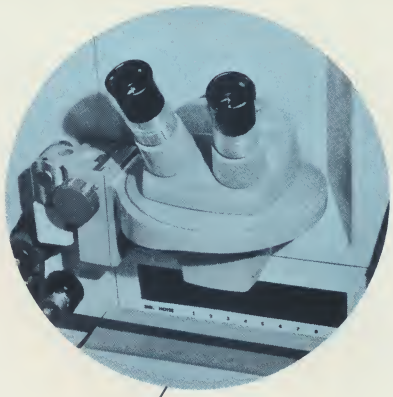
The GKI Model 97 is the only tester *designed specifically* to be a tester. It is not a modified computer tape drive. It utilizes no pinch rollers. A wrap capstan and controlled acceleration technique is used to eliminate stop/start damage. The oxide side of the tape comes into sliding contact only with the test heads during the entire passage of the tape, and only then on the initial pass. Direct-current tape reel motors are controlled through a closed loop servo design regulated by silicon controlled rectifiers to maintain the position of the tape loop in the vacuum column.

OUTSTANDING MODEL 97 FEATURES:

- Individual adjustment for each track of write head.
- Calibrated controls for each track testing circuit, to allow calibration check—front accessibility.
- Automatic stop on wide or narrow tapes.
- Direction-sensing flip-flop guides to insure proper tape guidance—uses flat rollers downstream from capstan and from supply reel; uses precision edge guides into capstan and onto take-up reel.
- Tape Tension adjustable from 5 to 12 oz.
- Precision-set error indication levels for signal and noise and for both amplitude and duration of the error.
- A wide variety of error counters and signal output meters for performing special tests and analyses, according to customer needs.
- Cleaning station to eliminate error-producing dirt and loose oxide prior to noise and signal tests.
- Automatic retest allows re-examination of any apparent error region up to three times to discriminate between true flaws and transient errors. Before each retest, the tape passes over the cleaning station to remove loose objects causing transient errors.
- Systems available to handle up to 1" tape on special order.

** The Model TR-2 Tape Tester is a modified Model 97 designed specifically for high speed testing of analog instrumentation magnetic tapes . . . analyzes 7 or 14 tracks for conformance to predetermined dropout amplitude and length as required by existing and projected Military and Federal Specifications. Details of the TR-2 available upon request.*

Some of the Features that Make the GKI Model 97 Tester a Flexible, Precise, Production Tool . . .

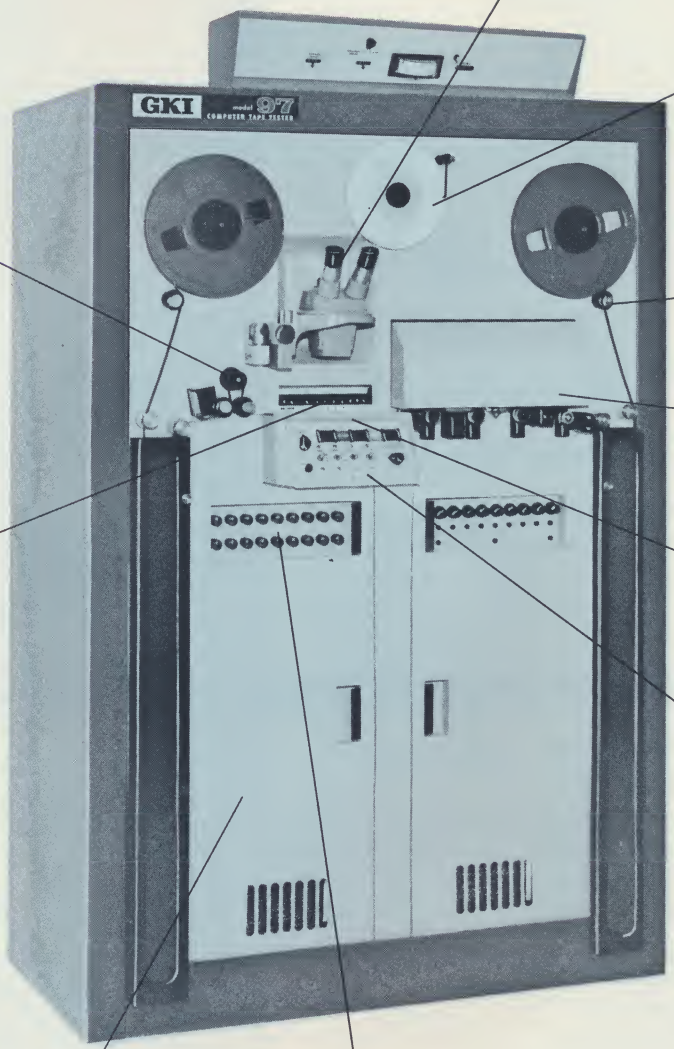


MICROSCOPE

Stereo-zoom microscope is always in position for instant use for microscopic examination of error regions. Magnification adjustable from 7 to 30 power. Can be swung out of tape path on pivot if desired.

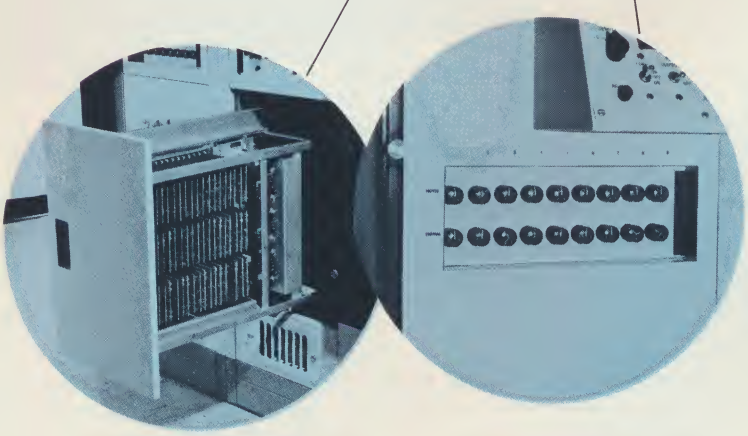
WRAP CAPSTAN

Wrap capstan insures smooth starting, driving, and stopping. Eliminates capstan burns and tape damage. The oxide surface is never touched by a driving or braking mechanism.



ERROR TRACK INDICATORS

Error track lights — one for each track — are located directly behind the tape at the work station. During test, flashing lights indicate each track in which a fault appears, and whether error is signal or noise. Appropriate lights remain lit during inspection of errors.

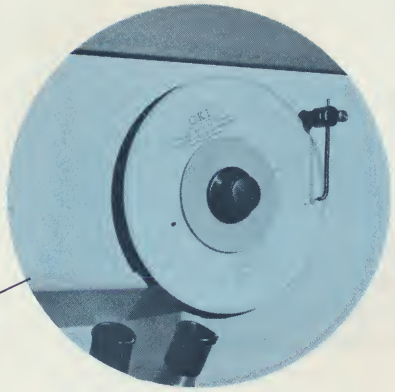


MODULAR SOLID STATE CIRCUITRY

All circuits are solid state. Circuit cards are carried in track-mounted trays for ready accessibility. Modular construction is used throughout for ease of maintenance.

CALIBRATION CONTROLS

Signal and noise calibration controls are conveniently located at the front of the machine. "Clock dial" controls facilitate setting and verifying calibration. Built-in signal level meter aids in calibration, and monitors signal level.



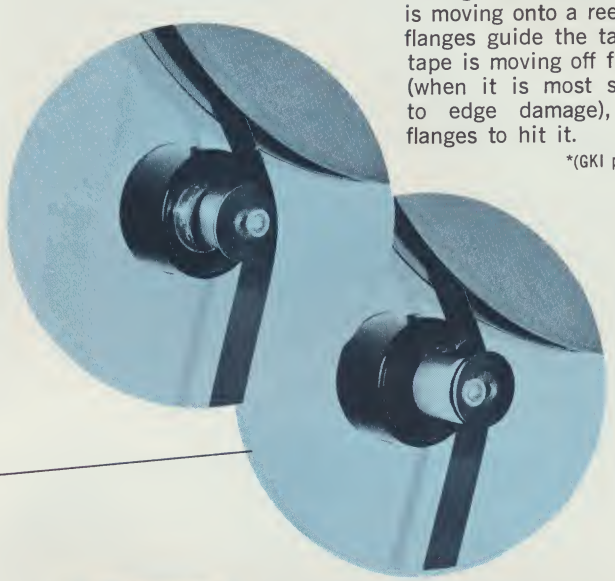
GRAPHIC ERROR CHART

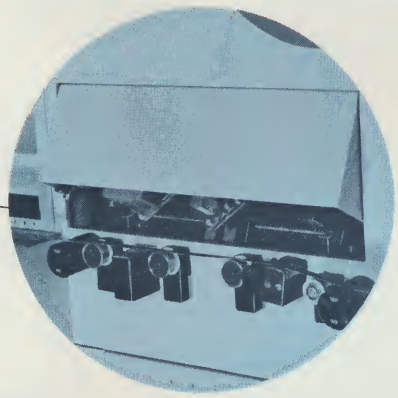
The error chart shows the number and location of error regions. It tracks tape motion accurately in forward and reverse. (The reverse capability is vital to correcting error regions on the return pass.) Circular chart fits easily into tape case. Counters total number of feet and number of errors for each reel.

FLIP-FLOP GUIDES*

Direction sensing flip-flop guides guard against damage to edges of tape. When tape is moving onto a reel, flip! the flanges guide the tape. When tape is moving off from a reel (when it is most susceptible to edge damage), flop! no flanges to hit it.

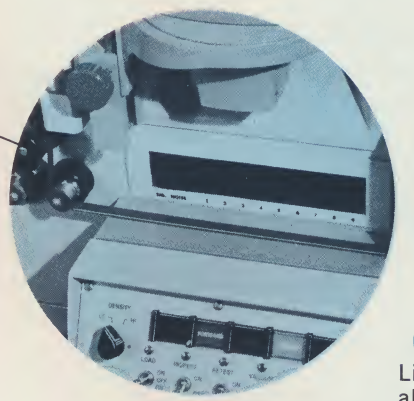
*(GKI patent pending)





RETRACTABLE HEAD ASSEMBLY

Head assembly retracts for loading and during reverse and rewind. Note precision tape guiding in vicinity of heads. Both sides of tape are cleaned and debris carried away by proprietary cleaning heads.



OPERATOR'S WORK STATION

Lighted 10x4½" work station is always in position for repair of flaws. Error regions can be stopped within ±1/10" in either forward or reverse. When flaws are clumped, the large work table makes it easy to scan and repair 10" of tape at each error stop.

CONTROL PANEL

All operating controls are located in one convenient control panel. Switches are computer console illuminated push buttons. Operator controls are minimized—many tester functions are automatic.

MODEL TC-3 MAGNETIC TAPE CERTIFIER

how the Model TC-3 works

The Model TC-3 attaches directly to the IBM 729 or 2400 series tape drive with one cable. This cable carries all tape drive control signals and write/read signals between the tape drive and the Model TC-3. No tape drive modification is required to use the TC-3.

Push buttons control the tape movement program and selection switches are used to control the mode of testing to be used.

The GAIN and THRESHOLD adjustment controls are simply adjustable to test for tape dropouts anywhere in the range of 20% to 100% of average maximum read-back signal level. Each of the seven or nine tape channels is individually adjustable. Setting of the test dropout level is determined by the user, depending upon the requirements of his data processing system.

The test consists of recording all "ones" on the tape and then reading these on the same pass. The loss of any single "one" or multiple "ones" is defined as a dropout.

HOW THE TC-3 SAVES MONEY

The Model TC-3 is designed specifically to test and maintain computer magnetic tapes, using an IBM 729 or 2400 series tape drive off-line (7 or 9 track format).

In one pass, the Certifier determines which areas of a tape will give dropout-free operation on a computer. As defects causing dropouts are detected, they are recorded in ink on a circular graphic chart and counted on an electro-mechanical counter. The operator may select a mode of operation which will cause each dropout error region of the tape to stop at a known position where he may examine and repair the tape defect.

The operator also may select a mode of operation which will automatically retest any detected dropout area. Adjustment and operation are so simple that the unit may be used easily by non-technical people with minimum learning time.

These features combine to produce the most useful magnetic tape certification tool available to the computer operation having a small tape library. The low cost of the Model TC-3 is rapidly amortized by reduction of lost computer time, by reclaiming valuable but previously unusable magnetic tapes for reliable future use, and decreased tape replacement costs.

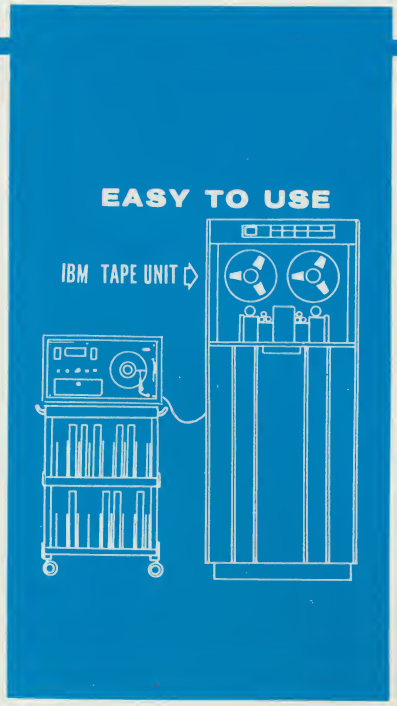
The TC-3 will cause an apparent error to be retested automatically twice after initial detection if the RETEST switch is placed in the ON position. This feature may be by-passed at the option of the operator by switching the RETEST switch to OFF.

The tape unit can be set to stop the tape at dropout locations for examination and tape repair by switching the ERROR STOP switch to STOP. This feature may be by-passed by switching the ERROR STOP switch OFF. In this mode the tape will run continuously and errors will be recorded on the chart and Error Counter.

In any mode of operation the normal reflective strip marking "End of Tape" will cause the transport to stop automatically.

FEATURES

- **Complete PORTABILITY. Desk or cart mountable.**
- **Completely SOLID STATE CIRCUITS for reliability.**
- **MODULAR construction for ease of maintenance. Standard logic modules used throughout.**
- **Requires no maintenance adjustments.**
- **Quick, SIMPLE operating adjustment options.**
- **Graphic Recorder. Provides a PERMANENT record of the number and location of defects.**
- **ERROR COUNTER. Provides a 4 decimal digit count of total defects in a tape.**
- **Caster Mounted Cart. Provides mobility to the TC-3 and temporary storage for the tapes to be certified.**
- **FORMAT—IBM 7 or 9 TRACK (729—2400 Series Tape Drives).**



SPECIFICATIONS

Tape Unit Applicability
IBM 729 II, IV, V, and VI or IBM 2400 Series

Tape Unit Control
Provides full control of the Tape Drive FORWARD, REVERSE

Write Control
TC-3 provides write signals to writing circuitry in 729 or 2400 Drive

Read Signals
Uses read signals from the 729 or 2400 preamplifiers

Bit Densities for Test
200, 556, or 800 b.p.i. at user's option

Signal Test
Seven or nine tracks; dropout level of each track individually adjustable at the front panel to conform to standard or local requirements

Dropout
Any one or more "ones" below threshold in a frame of information

Threshold Adjustment
Threshold of dropout adjustable anywhere in the range 20% to 100% of average maximum playback signal

Retest
Tests a dropout region automatically twice after initial detection before proceeding with certification of tape

Error Stop
Tape may be stopped automatically after dropout detection, at a fixed location, for examination and repair of the defect area

Amplitude Meter
Front Panel meter switchable to monitor output of any track

Error Signals for External Counter Use
Switchable positive or negative error pulses available for use with external pulse counter

Size
12 inches high, 21 inches wide, 20 inches deep

Weight
56 pounds

Power
115 volts ± 10%, 60 c.p.s.

MODEL K-80 MAGNETIC TAPE ERASER

FEATURES

- *Continuous operation*
- *One minute erasing time.*
- *High level erasure.*

SPECIFICATIONS

Erasure Level Range
80 db to 105 db below saturation.

Tape Width Capacity
¼″ to 1″
2″ available on special order.

Reel Diameter Capacity
3″ to 15″, NAB or IBM type reel hubs.

Erasure Cycle Duration
1 minute

Power Requirements
117 volts, 60 c.p.s. at approximately 7 amperes average, 14 amperes maximum.

Dimensions
21″ high x 19″ wide x 11¼″ deep for rack mounting. 23″ high x 22″ x 15″ deep including upright cabinet.

Indicators
Current monitor lamps provide assurance of proper operation.

Automatic
After pushing the start button the operator cannot interfere with completion of proper erasure.

the first heavy-duty magnetic tape bulk eraser designed for continuous operation over extended periods of time

. . . for COMPLETELY degaussing tapes containing classified information, so that they may be de-classified. (See DIA Instruction 65-3A)

. . . for removing proprietary information from tapes that are to be taken from your premises.

. . . for an added safeguard when dealing with critical jobs—eradicates data so thoroughly there's no risk of random signals or noise creeping in to distort the information you're writing.

. . . no heating problems even during extended and continuous operation.

Can be used routinely to erase all work tapes prior to mounting them on the tape drives.

DESCRIPTION AND THEORY OF OPERATION

The Model K-80 Magnetic Tape Eraser is a self-contained unit which removes any magnetic flux (signals and noise) from standard magnetic tapes. To operate the Eraser, the tape reel simply is mounted on the tape spindle and the start button is pressed momentarily. Thereafter, operation is automatic and the machine stops when the one-minute erasing cycle is complete.

Erasure is accomplished by causing the tape reel to rotate in a controlled 60 cps magnetic field which is very large when the erasing cycle starts. The field is reduced to zero at a constant slow rate by means of a motor-driven variable transformer that supplies power to three separate erasing magnet coils mounted behind the Eraser panel.

Three indicator lamps mounted on the panel are energized by separate secondary coils wound on each of the erasing magnet cores. Thus, the indicator lamp brightness varies directly with the magnetic field produced by each coil, providing visual assurance that erasure is proceeding properly.

INSTALLATION

The Model K-80 Magnetic Tape Eraser is supplied in your choice of cabinet, for use either horizontally or upright, as illustrated. It can also be supplied ready for mounting in a standard 19-inch rack.

MODEL E-36 COMPUTER TAPE ERASER

a self-contained unit

DESCRIPTION

The Model E-36 Computer Tape Eraser is a self-contained unit which removes magnetic flux (data and noise) from magnetic computer tapes on 10½ inch diameter IBM type reels. To operate the Eraser, the tape reel simply is mounted on the tape spindle and the start button is pressed momentarily. Thereafter, operation is automatic and the machine stops when the 30 second erasing cycle is complete.

Erasure is accomplished by causing the tape reel to rotate in a controlled 60 cps magnetic field which is very large when the erasing cycle starts. The field is reduced to zero at a constant slow rate by means of a motor-driven variable transformer that supplies power to the erasing magnet coil mounted behind the Eraser panel.

An indicator lamp mounted on the panel is energized by a secondary coil wound on the erasing magnet core. Thus, the indicator lamp brightness varies directly with the magnetic field produced by the coil, providing visual assurance that erasure is proceeding properly.

FEATURES

- **High level erasure of all data and noise.**
- **One-half inch wide computer tapes on 10½ inch diameter IBM type reels are accommodated.**
- **Simple push button operation for START; erasure cycle is otherwise completely automatic.**
- **Fast, 30-second erasure cycle.**
- **Indicator lamp monitors erasure current level and assures proper operation.**
- **Portable, desk top unit.**
- **Dimensions: 14⅞″ wide, 11½″ deep, 7¾″ high.**
- **Power requirements: 115V AC, 60 cycle, 5 amperes.**

GKI MODEL 580 MAGNETIC TAPE CLEANER

for efficient, economical cleaning

The GKI Model 580 Tape Cleaner is an efficient, economical means for removing the error-causing dirt which collects on all magnetic tape in normal computer use.

This dirt—mainly particles of oxide or backing material dislodged from the tape itself—causes loss of contact between the computer reading or writing head and the surface of the tape. Surface dirt is thus responsible for machine errors and the resultant loss of machine time.

You can avoid this loss by cleaning your tapes regularly with the GKI Model 580 Magnetic Tape Cleaner, which has these outstanding features:

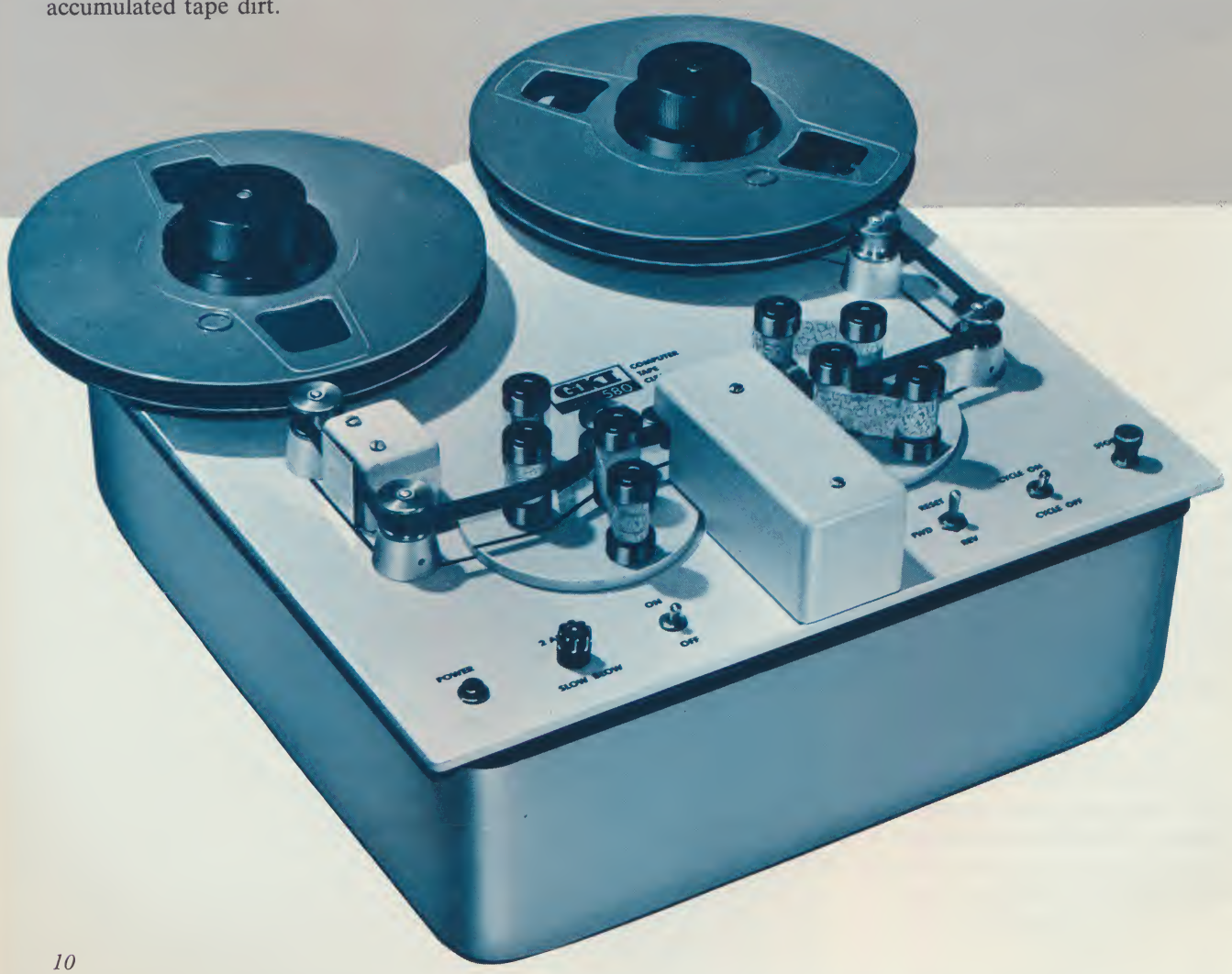
CLEANING METHOD. The cleaning blade is a self-sharpening, non-magnetic disk, which is rotated slowly as it cleans, so as to evenly distribute wear due to abrasion and heat due to friction. If reasonable care is taken to avoid nicking the edge with hard objects, the blade will never require replacement.

The blade is continuously cleaned by a simple wiping device which can be removed occasionally to dispose of accumulated tape dirt.

Loosened dirt is removed from the tape by wipers on each side of the blade, two for each direction of tape travel. The wiping assemblies are mounted on solenoid-actuated turrets, so that the wiping assembly that "follows" the blade is engaged to the tape.

When the tape automatically reverses, the wiper turrets automatically adjust to the new tape travel direction. The wiper fabric is mounted on spools so that a clean section of fabric can be advanced to the tape contact area after each cleaning cycle.

AUTOMATIC BI-DIRECTIONAL OPERATION. After the Model 580 has cleaned an entire length of tape, the end-of-tape marker triggers a photoelectric switch which automatically reverses tape motion. The 580 then cleans the entire length of tape in the opposite direction. No operator need be present during the cleaning cycle, which is completely automatic.



A UNIQUE SELF-SHARPENING ROTARY CLEANING BLADE

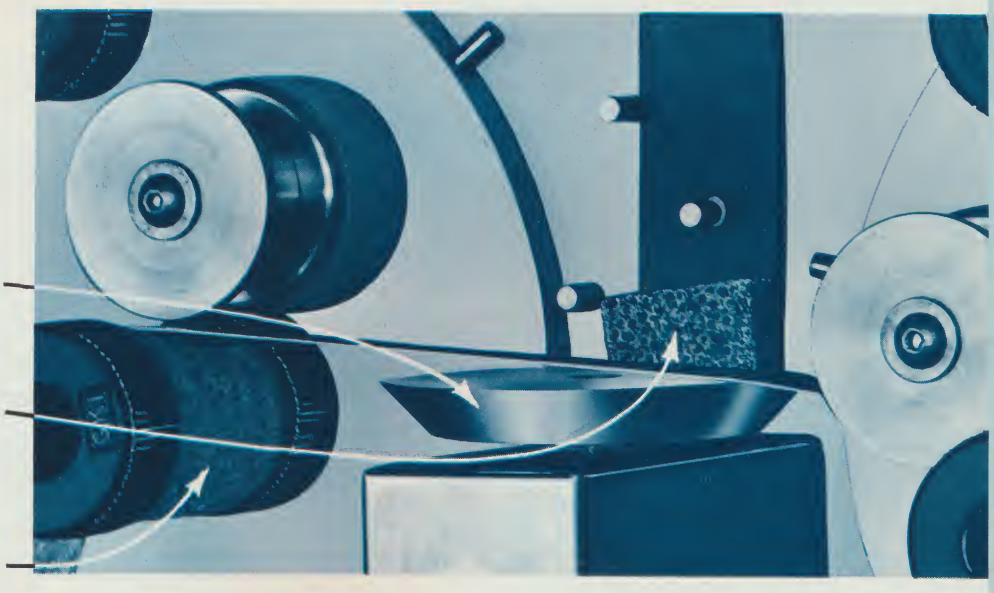
As the blade cleans the tape, the tape continuously hones the blade so that it always has a sharp edge. This eliminates the danger of a dull or nicked blade scratching the tape, as well as the need to replace the blade periodically.

CLEANING ELEMENTS

BLADE: *removes imbedded dirt, oxide lumps, and other foreign materials, bonded or unbonded.*

BLADE WIPING PAD: *continuously removes dirt from blade edge, preventing its transfer back to tape.*

TAPE WIPERS: *special cleaning tissue collects and retains the dirt removed from the tape.*



SPECIFICATIONS

Tape Capacity:
½" wide tape on IBM-type reels up to 10½" diam.

Operation:
Automatic two-pass cleaning cycle cleans tape completely in both directions.
(Single pass operation may also be selected, if transfer of tape to a different tape reel is desired.)

Cleaning Speed:
Approximately 150 ips average tape speed.
Approximately 6 minutes to clean a 2400′ tape in both directions.

Controls:
In normal, automatic operation, the FORWARD switch initiates the entire cleaning cycle. The following switches are available if variations in mode of operation are desired:
ON/OFF
CYCLE ON/CYCLE OFF (OFF if one pass operation is desired.)
STOP
RESET/FORWARD/REVERSE

Fail-Safe Braking:
In the event of power failure, brakes are applied automatically, insuring against "spilling" of tape.

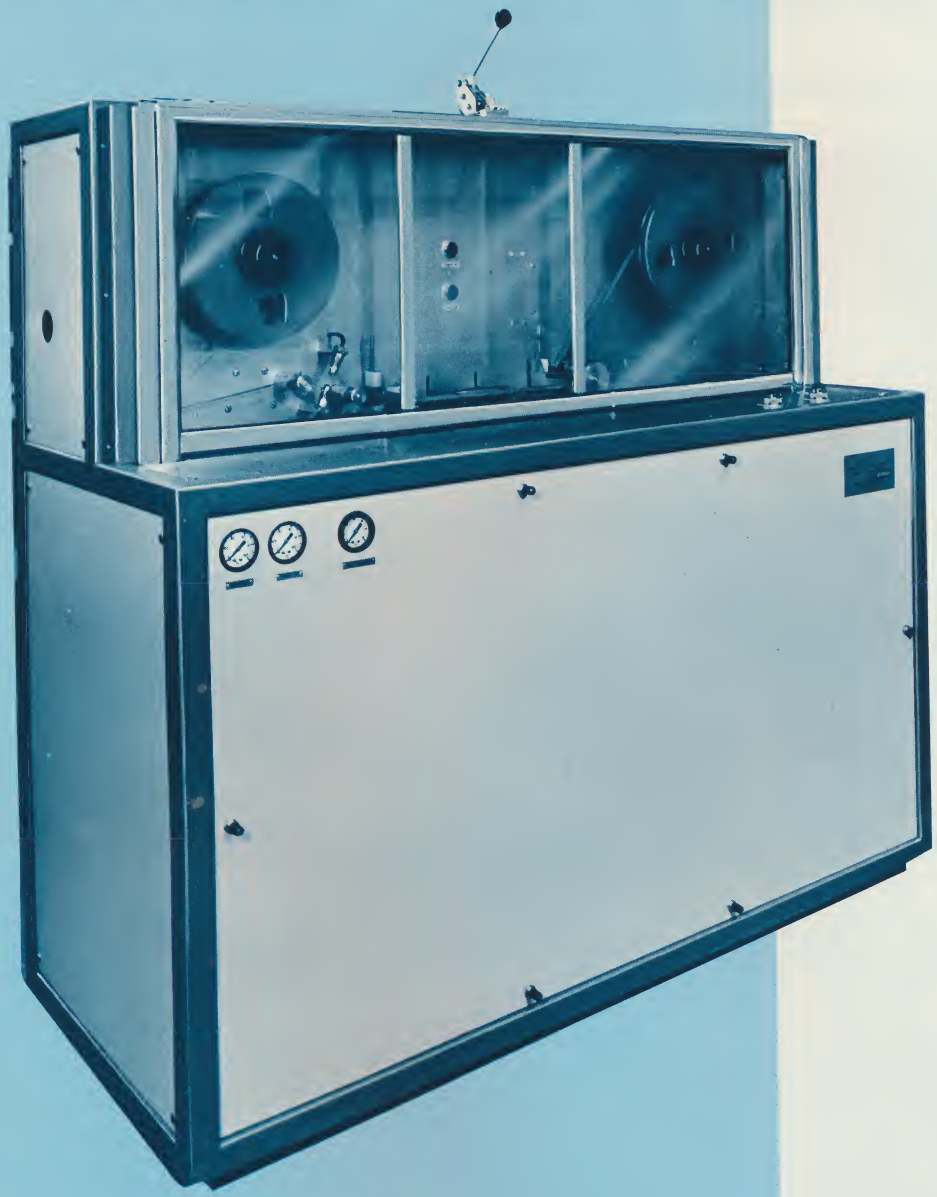
Precision Guides:
All tape guiding elements rotate on precision bearings and are mounted on a heavy base to insure perfect tape alignment and maximum safety in tape handling.

Power Requirements:
115V AC, 60 cps, 1¼ amp.

Dimensions:
19" wide, 8¾" high, 19¼" long.

Mounting:
In cabinet, for table top use. Can be operated vertically or horizontally.

MODEL CT-2 KINESONIC TAPE CLEANER



SPECIFICATIONS

Electrical power requirements: 220 V, 60 cycle, 1 phase with neutral, 23 amps per line.

Air conditioning and humidity control requirements: Standard comfort air conditioning 65-80°F, 40-50% relative humidity.

Maintenance requirements: Routine cleaning of machine, rollers and guides (operator). Routine change of air and fluid filters (mechanical technician).

Tape passing speeds: One pass cleaning and drying—300 ft/min.

BTU generation: Approximately 10,000 BTU.

Reel Sizes: ½″ or 1″ tape width on NAB reels of 10½″, 14″, or 15″ diameter for instrumentation tape and ½″ x 10½″ computer reels.

the cleaning process

Magnetic tape is cleaned in a one-pass operation removing all unbonded self and environmental dirt. Loose oxide, backing fibers, and other foreign materials from both front and back tape surfaces are scientifically removed. The edges of the tape are thoroughly cleaned as well—in blade type cleaners, dirt on the tape edges is often missed in the cleaning process.

In the KINESONIC cleaning machine the primary tape cleaning action occurs with the tape immersed in water containing a small proportion of a special cleaning detergent. While immersed the tape passes at 300 ft/min. through the KINESONIC transducers. The tape is twice subjected to intense fluid cavitation in the presence of a rapidly flowing fluid.

The KINESONIC process creates energy ranging over a spectrum from the subsonic to the ultrasonic; this energy provides very effective cleaning, removing unbonded self-dirt and environmental dirt from both the surfaces and edges of the tape.

The cleaning fluid, after being exposed to the tape, is pumped through a filtering sytsem in which all dust, dirt, and other debris resulting from the cleaning action are removed from the fluid. Only clean filtered fluid is allowed to re-enter the area where the tape cleaning takes place. This filtering process prevents the removed foreign matter from being re-deposited on the clean tape. The tape is dried by air flowing at high velocity. The tape drying operation aids in the tape cleaning by induced sinusoidal vibration of the tape itself as it passes through the drying device. Any partially broken tape particles which may have been so firmly attached as to resist the KINESONIC cleaning are broken loose and returned to the water flow system during the act of vibrating the tape surface in the dryer.

The CT-2 Cleaner does not employ any devices which tend to abrade, tear, groove, stretch, or otherwise damage the tape surfaces or edges. The tape is *not* scraped, brushed, or abraded—cleaning is confined entirely to the action of fluid and air.

GKI MODEL 560 TAPE WINDER

why it is needed

General Kinetics Incorporated has performed extensive research into the causes of magnetic tape failure. Mathematical analyses have been made of the static physics affecting the winding and storage of thin strip materials on reels. These analyses showed that when tapes are wound on reels of standard type, according to the common constant tension or constant torque winding patterns, the elastic storage of energy in the tape roll slowly dissipates by plastic flow in a non-uniform fashion. The result? The tape roll eventually comes apart at a predictable point.

Ordinary winding methods cause the inner portions of the roll to be stored under extreme inward pressures and with negative tension in each lamina of tape. In contrast, the outer portions of the roll enter storage with much lower inward pressures and with positive tension in each lamina. At a point ¼ to ⅓ of the distance from the hub to the outside diameter of the roll, the stored tension undergoes a negative to positive transition. It is here that plastic flow of the inner and outer portions occurs in opposing directions, resulting in breakup of the roll.

When tape rolls break at the stored tension transition region, additional problems occur when they are put into service. Even under the best conditions, these rolls can cinch and produce folds and abrasions due to inertial reaction of the loosened outer portion. Such action, of course, will produce dropouts. In addition, axial slippage of a tape roll, which often occurs spontaneously as the pile is disrupted, produces a skewed length of tape, and attendant time displacement errors.

how it works

GKI's Programmed Tension Winder consists of a tape transport which winds magnetic tapes on standard reels according to a theoretically-derived and experimentally-proven pattern of tape hold-back tension. This tension pattern prevents the creation of a tension transition region and thereby eliminates this important cause of tape failure.

During the winding process, the diameter of the wound roll is measured continuously by a balanced follower arm resting lightly on the tape roll edge. The instantaneous position of the arm is transmitted mechanically to a cam system which continuously varies the winding tension according to the calculated program. Tape rolls, as they come from the winder, are smooth, compact and stable and will remain so for extended periods, even under wide variations of temperature and humidity.

560 WINDER SPECIFICATIONS

Tape Capacity

½-inch tape on reels up to 14 inches in diameter.

Winding Speed

10½-inch reels—700 ft/min. (average)
14-inch reels —850 ft/min. (average)

Tension Control

Programmed Tension. Programmed tension control as per Interim Federal Specification W-T-0045. A single, universal cam provides a tension pattern designed to keep the tape pile smooth and solid in shipping and storage. Compensation is made for various sizes and types of reels with an adjustable linkage. Follower arm positions the programmed tension control cam by continuously measuring and "feeding back" radius of the wound reel.

Guides

All rollers of guiding system are mounted on precision bearings. Guides are spaced to accommodate tape which meets Federal and MIL width specifications.

Front Panel

Heavy cast aluminum front panel assures rigid alignment of tape guiding elements and stability of the winding pattern.

Power Requirements

117 volts, 60 cycle, 5 amperes.

Dimensions

41″ high x 21″ deep x 22″ wide.

Weight

108 lbs. with cabinet.

Optional Accessories

NAB Reel Hub Adapter (IBM reel hubs are standard).

Tape Width Conversion Kit. Permits conversion from ½-inch tape width to any other standard width up to and including 1 inch.

Precision Guiding and Pack Wheel. Provides additional guiding element precisely at the point where the tape joins the tape pack, excluding air from the wound reel. For winding to extremely close tolerances.

FEATURES

The Model 560 Tape Winder

- Improves performance of magnetic tape.
- Produces smooth, compact, stable rolls by off-line winding.
- Offers winding tension control patterns designed to suit each particular combination of tape material and reel type.
- Eliminates folds and abrasions caused by loose relaxation of tape.
- Reduces development of tape skew.
- Reduces tape storage and shipment problems.
- Minimizes effects of humidity and temperature changes.
- Handles tape widths up to 1″.

One of the most interesting combinations of GKI Tape Machines is located at The National Aeronautics and Space Administration

Goddard Space Flight Center

Greenbelt, Maryland

This installation was described in the Goddard News as shown.

GODDARD NEWS

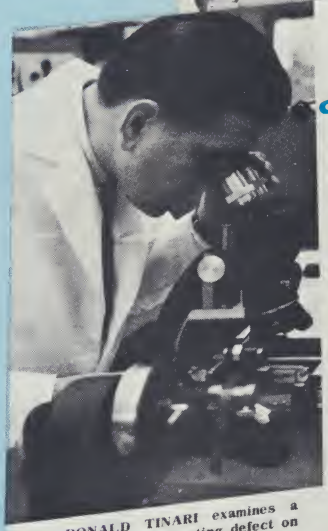
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

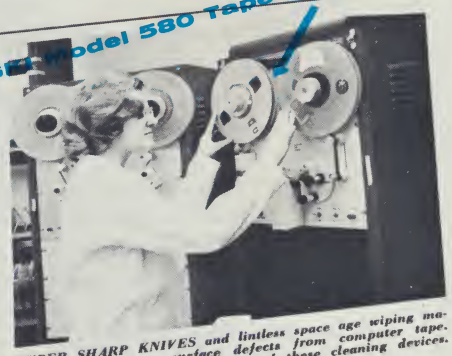
VOLUME X, NUMBER 11 FEBRUARY 21, 1966

GKI Model 580 Tape Cleaner

Goddard New



DONALD TINARI examines a magnetic tape coating defect on a length of computer tape.



SUPER SHARP KNIVES and lintless space age wiping material help remove surface defects from computer tape. Sharon Crewe operates a bank of these cleaning devices.

GKI Model CT2 Kinesonic Tape Cleaner

Goddar

The Magnetic Tape Quality Co
W1, Building 16, became operati
Virgil H. Byrd, Head of the Recor
It has the capability of providin
Acceptance Testing, and Magnetic

Qualified Produc

The QPL consists of suppliers
and have passed the qualification
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With the establishment of a
instrumentation tape procurement
control over the quality of tape
On this type of procurement
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sents a savings to NASA of over
Goddard's Cost Reduction Officer
The R&D support for the Ma
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E-129.

Accepta

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Magnetic T

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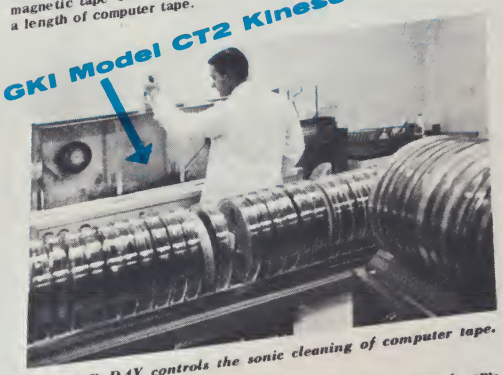
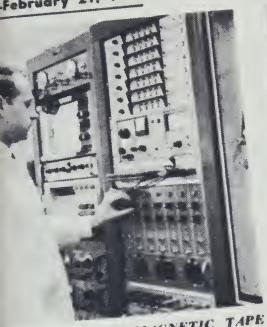


RONALD DAY controls the sonic cleaning of computer tape.

TONY FOMINAYA accepts the first completed reel of computer tape rehabilitated at the new Magnetic Tape Quality Control Center.

GKI Model 7A Tape Tester



STRUMENTATION MAGNETIC TAPE
ester checks the magnetic coating on a
pe for imperfections. A defect the size
ticle found in cigarette smoke can be
by this device.

's New Magnetic Tape Facilities

Center, located in Room
January 1, 1966, reports
Systems Section (NEOD).
ualified Product Lists.
Rehabilitation.

List (QPL)

e products have been tested
specified in Goddard Mag-
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for magnetic computer and
ddard now is able to exercise
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965, Goddard has realized a
nputer type procurement and
e procurement. "This repre-
million," said Stanley Kovell,

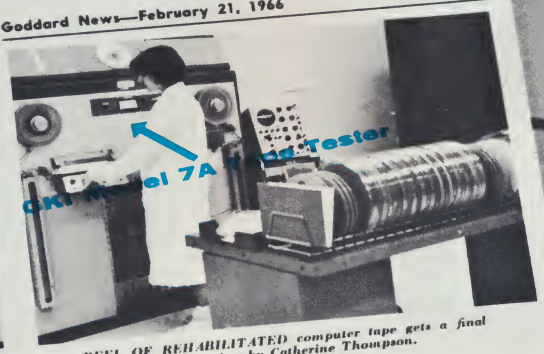
e Tape Quality Control Center
boratory, Building 12, Room

Testing

a manufacturing company to
pe and upon receiving their
tests are performed to assure
ndards. Each lot of tape de-
sampled, using an Acceptance
mples selected and tested as
is.

Rehabilitation

trol Center will also perform tape
e of its primary functions. Re-
puter tape is expected to be about
an average price of $14.00 for
magnetic tape, a savings of $10.00
e present number of tapes stored
could be rehabilitated, a savings



A REEL OF REHABILITATED computer tape gets a final quality control inspection by Catherine Thompson.

of $90,247 would be realized. Magnetic tape rehabilitation will also reduce the quantity of new tape procurement.

Users of Goddard's procurement and acceptance testing, in addition to our own center, are: STADAN Network, Manned Flight Operations, Universities, and the Manned Spacecraft Center in Houston.

New Magnetic Tape Clean Room

The new clean room for the Magnetic Tape Quality Control Center, recently completed here at Goddard, performs two basic functions. The first is related to quality control, where incoming magnetic tapes from various manufacturers are inspected for conformance to specifications. The second is the cleaning and rehabilitation of used and contaminated tapes. The intent of this program is to provide reliable magnetic tape for data recording.

Magnetic Tape

Magnetic tape is a data carrier—perhaps the most valuable and widely used data carrier yet devised for data processing systems. It is an efficient functional medium with enormous capacity and it has outstanding virtues: ease of handling, long-life expectancy, and a capability for perfect performance. However, magnetic tape's great virtues are subject to simple cancellation factors: contamination or careless handling.

There are two principal fields of tape application: (1) instrumentation, and (2) computer.

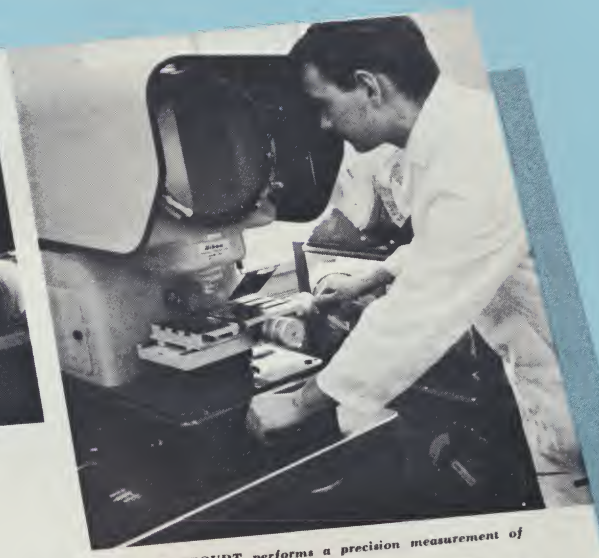
Telemetering Instrumentation

In the telemetering field, the recorded bandwidth has moved from 100 kc to 1½ megacycles (this means that the recorded wavelength has moved down from 8 to 9 tenths of a mil. to less than 1 tenth of a mil.).

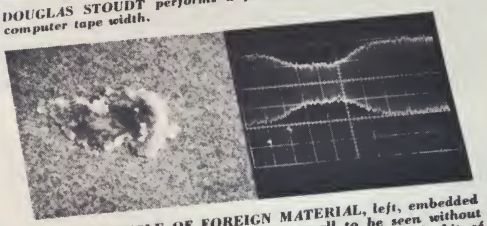
Computer Tapes

Major state-of-the-art changes have occurred in recent years in the two major branches of the industry. In the field of computer tape, packing densities have moved from 200 bpi (bits/inch) up to 1600 bpi.

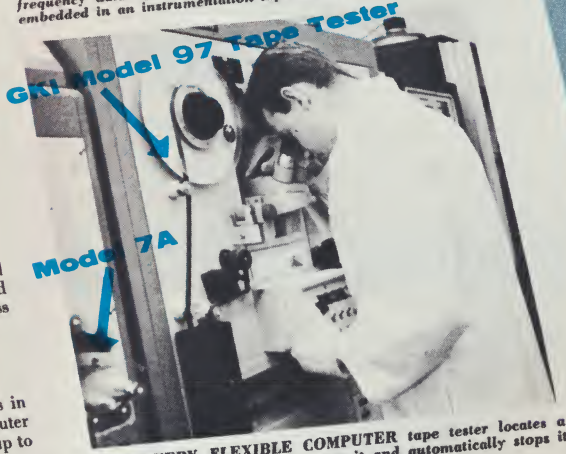
Those at Goddard with problems in the magnetic tape area are invited to contact Virgil Byrd, Ext. 5080.



DOUGLAS STOUDT performs a precision measurement of computer tape width.



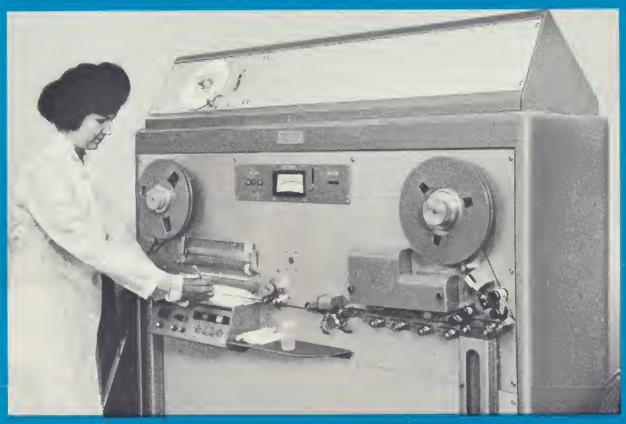
THIS PARTICLE OF FOREIGN MATERIAL, left, embedded in the magnetic tape coating, too small to be seen without magnification, can cause the loss of a very valuable bit of recorded data. This photo of an oscilloscope, right, dramatically shows the disturbance created in a bit of recorded high frequency data by the minute particle of foreign material embedded in an instrumentation tape coating.



THIS VERY FLEXIBLE COMPUTER tape tester locates a tape defect, classifies it, counts it and automatically stops it under a microscope for inspection.

Reprinted by GKI 5-1-66. This reprint does not necessarily constitute an official endorsement of this product by the government.

4. Special test equipment writes and then reads the tape. It detects signal dropouts, tape noise, and dynamic tape skew. Error regions are automatically marked on a circular graphic recorder. On this first test pass, after KINESONIC cleaning, those tapes which certify to customer specifications pass directly to Programmed Tension Winding and Packaging.



5. Tapes which do not meet specifications at Step 4 are then manually repaired and retested. Particles of oxide, backing material, and foreign matter that have become bonded to the surface of the tape, and other correctable error regions, are repaired by skilled technicians. Tapes that still do not meet customer specifications are rejected.

6. Tapes certified to specifications after Manual Repair and Retest are then precision wound on a GKI Programmed Tension Tape Winder to produce a reel of tape impervious to damage from handling, shipping, or storage. This winding meets Federal specifications found in W-T-0045 (GSA-FSS).

7. Finally, the "GKI Certified" label is applied to all tapes meeting customer specifications. The tapes are then carefully packed for return to the tape library. Enclosed with the returned tape is the all-important report on the test results. A copy of his report and the circular graphic recording are retained by GKI in an archive file to provide a history of Tape Preventive Maintenance and its results as applied to your magnetic tapes.

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